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ML Directorate develops grease recommended for C-5

By Timothy R. Anderl, Materials and Manufacturing Directorate

A C-5 Galaxy takes off from an airfield at a deployed location. By incorporating the ML-developed grease on the C-5, the Air Force could solve several challenges related to wear, corrosion and rust in the landing gear assembly of the C-5 aircraft. (Air Force photo by Tech. Sgt. Justin D. Pyle)

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A low-cost, multi-purpose grease developed by the Air Force Research Laboratory received a positive evaluation from Air Force maintainers following nearly 1,529 airframe hours, or 11 months of operation, on the C-5 aircraft.

Equipment specialists from Dover Air Force Base, Delaware, who evaluated the grease's performance during a rigorous inspection of the aircraft in December 2003, have recommended that the C-5 convert to the new moisture-resistant and high-load carrying grease pending review of an Interim Status Report and approval by the C-5 System Program Office.

In September 2002, two C-5 landing gears were greased with the multi-purpose grease, MIL-PRF-32014, and two landing gears, which were packed with the current grease, were identified as control gears. To date, the new grease has acquired 1,529.6 airframe hours, 351 total landings, 299 full-stop landings and 360 gear cycles.

"By incorporating the stable, low-cost, rust-inhibiting grease, the Air Force could solve several challenges related to wear, corrosion and rust in the landing gear assembly of the C-5 aircraft," said Ms. Lois J. Gschwender, an engineer from AFRL's Materials and Manufacturing Directorate's Nonstructural Materials Branch. "During testing conducted by the University of Dayton Research Institute on-site contractors at the directorate, the grease demonstrated water washout resistance, high-temperature and high-speed performance. During flight testing, the new grease has proven that it provides superior anti-wear and anti-rust performance and will provide a significant cost advantage due to reduced maintenance, part replacement and system failures."

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AFRL engineers receive honors at conference

by Pete Meltzer Jr., Materials and Manufacturing Directorate, with additional input from AFRL Public Affairs

Dr. Darnell E. Diggs

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Three Air Force Research Laboratory engineers have been selected to receive honors during the Black Engineer of the Year Conference, in Baltimore, Md., Feb. 21.

Dr. Darnell E. Diggs, Materials and Manufacturing Directorate, has been selected "black engineer of the year" in the "most promising scientist in government" category. Dr. Diggs is a physicist in the survivability and sensor materials division, Wright-Patterson Air Force Base.

Dr. Diggs conducts research in the survivability and sensor materials division's optical materials research group, where his efforts have been focused primarily on materials for high-performance optoelectronic devices.

One of Dr. Diggs' projects is improving polymer-based electro-optic modulators that provide critical advantages over devices made from other materials. This includes overcoming one of the primary limitations to these devices, an optimum cladding layer.

Dr. Diggs has demonstrated his expertise with various optical characterization methods for measuring refractive index, propagation loss, electrical conductivity, optical nonlinearity and low and high frequency dielectric constants, and in determining materials compatibility for state-of-the-art core and cladding materials.

Ms. Ellen Montgomery, Science and Technology Strategic Planner in the Plans and Programs Directorate, will receive a Modern Day Technology certificate. Ms. Montgomery is responsible for the development and publication of the Air Force Science and Technology Plan.

Also receiving the Modern Day Technology certificate is 1st Lt. Kathryn Parker, Space Vehicles Directorate, Kirtland Air Force Base, N.M. Lieutenant Parker specializes in spacecraft power and altitude control systems. @

Additional newsletter stories online at

http://www.afrl.af.mil/news/index.htm

Bumper mounts fabricated for forward deployed robots

by Timothy R. Anderl, Materials and Manufacturing Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Engineers at the Air Force Research Laboratory's Materials and Manufacturing Directorate (ML) have fabricated and delivered a bumper mount and ramp which allows deployed forces to carry small robots on the back of armored Humvees.

The bumper mount and ramp, delivered to meet a request the directorate received from United States Central Air Forces and Air Combat Command in November, allows explosive ordnance disposal people who transport and operate robots to haul them without having to use a trailer. Robots are used for a variety of force-protection, counter-terrorism and EOD operations, including improvised explosive device neutralization and reconnaissance.

"The modified bumper mount and bi-fold, quick-release ramp technologies will have significant value to personnel conducting EOD and counter-terrorism activities in forward deployed locations such as Operation Iraqi Freedom," said Marshall "Doc" Dutton, an engineer from ML's force protection branch at Tyndall Air Force Base, Fla. "The technologies overcome challenges related to the complicated assembly of ramps currently being used and show significant advantages over trailers, which have limited maneuverability. Deploying this technology is expected to increase the safety of EOD personnel, who have had to manually approach Improvised Explosive Devices when the current trailer and ramps' limitations impede the deployment of a remotely-operated system or robot."

Just a few days after receiving the request, ML engineers identified a commercial off-the-shelf, all-terrain vehicle mount, which was compatible with a class-three universal trailer hitch, and could be used, in conjunction with a ramp, to mount and carry the robots. Teaming with Discount Ramps in West Bend, Wis., six prototype bi-fold ramps were fabricated.

Developed by a subsidiary of Northrop Grumman Corporation, the Andros Mark VI robot is one such robot currently being used in support of Operation Iraqi Freedom that will be carried using the new technologies. Andros Mark VI is a heavy-duty, all-terrain, multi-tracked hazardous duty vehicle that is equipped with manipulator arm, gripper, TV cameras, lights and two-way audio. The robot weighs about 350 pounds, is 60 inches long and remotely operated using an operator control unit. @

ML develops from page 1

According to Ms. Gschwender, the directorate first began working with grease companies to develop the multi-purpose grease in the late 1980s. The team, led by Mr. Ed Snyder, had a goal of finding a commercial source of grease to replace the mineral oil sodium soap thickened product used in cruise missile engines. The mineral oil product reacted negatively to air moisture and was bleeding out of bearings while in storage.

"Greases are used in military applications to improve and ensure the performance of moving parts," said Ms. Gschwender. "When compared to liquid lubricant systems, grease systems provide significant advantages in the design of a system. Greases are self-contained, which eliminates the need for pumps, tubing, heat exchangers and other extra hardware that increase the weight and design requirements of a system."

Because no appropriate greases were commercially available, and only a small volume of grease was required for the missiles, ML researchers and contractors from AMOCO designed unique lubricating grease, which was ultimately assigned the MIL-PRF-32014 military specification. The rigorous performance requirements in the specification require the grease composition to include anti-oxidant, anti-wear, and anti-rust ingredients.

Following validation testing by several military agencies and by Williams Engine Company, the grease was adopted for the cruise missile with great success, said Ms. Gschwender. When the original supply of grease was used up, there was still no commercial supply available because the usage volume of grease for the cruise missile was very small. Again, AMOCO custom made and delivered the second batch of the lubricant to the Air Force in 1994.

Mr. David Marosok, a lead C-5 landing gear engineer at Ogden Air Logistics Center, Utah, approached AFRL to solve a dilemma resulting from the implementation of very expensive grease ($5,000 per gallon) that had been recommended by a contractor to solve corrosion and rust problems. This grease had in fact aggravated the problems, Ms. Gschwender said.

Following collaboration with AFRL, where participants analyzed wear and rusting challenges that plagued the landing gear of the C-5, ML researchers, including Ms. Gschwender, Mr. Snyder and Dr. Shashi Sharma, determined that a MIL-PRF-32014 qualified grease could offer improvements in the landing gear. "The C-5 landing gear is regularly exposed to moisture and rain, air, bacterial decontaminants, and other corrosion and wear encouraging phenomena, which at times causes significant problems for operators, and challenges for systems maintainers," Ms. Gschwender said. While AMOCO was unavailable to manufacture the grease, Nye Lubricants, a small business that specializes in specialty lubes, commercialized qualifying grease called Rheolube 374A.

AirBP also has a grease qualified to the MIL-PRF-32014 specification they call Aeroplex 3214. The two current suppliers were attracted to the potential larger volumes offered by use in the C-5 aircraft, Ms. Gschwender said. "MIL-PRF-32014 is expected to cost less than $100 per gallon and to provide the desired improvement in performance over both the original grease and the contractor recommended grease," she added.

In late November and early December 2003, experts at Dover's Equipment Maintenance Squadron, who provide maintenance to the C-5 fleet beyond normal flight line servicing, conducted an isochronal inspection of the C-5 aircraft where the ML-developed grease was in use. The parts were observed and grease samples were taken for analysis by ML personnel at their facilities at Wright Patterson Air Force Base.

After examining the parts, and showing maintenance specialists test coupons with differing greases to demonstrate how they perform, aircraft authorities agreed to change the technical orders for the C-5 to enact conversion to the new grease in all grease lubricated aircraft applications.

"The consensus of Dover's maintenance operation specialists was that the conversion to MIL-PRF-32014 should occur as soon as possible," Ms. Gschwender said. "We also expect the grease to improve performance in other areas of the aircraft, and to replace many currently used military greases. This grease has demonstrated the potential to become 'near-universal.'" @

AFRL Headquarters announce new chief technologist

by 1st Lt. Morgan J. O'Brien, AFRL Public Affairs

Dr. Thomas A. Cruse

WRIGHT-PATTERSON AIR FORCE, Ohio — The Air Force Research Laboratory, headquartered at Wright-Patterson Air Force Base, introduced new chief technologist, Dr. Thomas A. Cruse on January 5.

In his new post, Dr. Cruse serves as the primary advisor on science and technology and primary authority for the technical content and quality of the science and technology portfolio to the AFRL commander.

"Dr. Cruse joins us from Vanderbilt University under the Intergovernmental Personnel Act," said Major General Paul D. Nielsen, AFRL commander. "I am excited about the tremendous motivation, broad experience and professionalism he brings to AFRL."

Prior to serving as both private consultant and professor emeritus of mechanical engineering at Vanderbilt, Dr. Cruse's nine years of teaching at the school were as the H. Fort Flowers Professor of Mechanical Engineering.

Dr. Cruse's Air Force resume boasts a broad range of involvement. He has served on seven Air Force Scientific Advisory Board S&T Quality reviews involving four AFRL Technology Directorates, chairing one. "My SAB experiences with AFRL made me an enthusiastic supporter of what AFRL does and the quality of the personnel in the lab," Dr. Cruse said.

With ties to AFRL through a couple of predecessor organizations, Dr. Cruse anticipates his experiences prepare him for the new position. "I have a long research connection with the Air Force," said Dr. Cruse, who worked with the Air Force Materials Lab while a professor at Carnegie Mellon, the Aeropropulsion Lab while at Pratt & Whitney Aircraft, and with both the Propulsion and Air Vehicles Directorates while a program manager for probabilistic design at Southwest Research Institute.

The relocation to Dayton marks a return to Ohio for Dr. Cruse. During World War II, his father worked as a foreman building B-24s for the Goodyear Company in Akron. His father's jobs required several moves during his childhood. These moves took him to various homes in Indiana and Ohio and eventually, southern California.

Dr. Cruse earned an undergraduate degree in mechanical engineering and a master's degree in engineering mechanics from Stanford University, Palo Alto, Calif. He received a doctorate in engineering mechanics from the University of Washington in Seattle.

"Dr. Cruse's appointment acknowledges his exceptional executive leadership ability and strong background from his experience in academia." General Nielsen said, "The position calls for him to analyze and integrate multiple complex technical programs and to lead a diverse collection of professional scientists and engineers."

Dr. Cruse is enthusiastic about coming to AFRL. "My principle goal is to help AFRL's directorates achieve or maintain world-class research in support of the Air Force's mission. I view my job as a facilitator, communicator and hopefully, stimulator," he said.

In his free time, Dr. Cruse is an instrument-rated private pilot who enjoys the outdoors. He and his wife backpack, raft, ski and fly fish near their permanent home of Pagosa Springs, Col.

Under the Intergovernmental Personnel Act, Dr. Cruse will serve a two-year term, which is renewable for one additional term. @

Airborne Laser engineers mix missile-destroying chemicals

by Ken Englade, Airborne Laser System Program Office

KIRTLAND AIR FORCE BASE, N.M. — Airborne Laser (ABL) engineers have successfully prepared and assessed a 1,200-gallon batch of chemicals that help make up the delicately balanced formula necessary to create a laser beam capable of destroying a ballistic missile, according to Col. Ellen Pawlikowski, Kirtland-based ABL program director.

The event occurred Dec. 18, 2003, at the ABL facility at Edwards Air Force Base, Calif., two weeks after a shipment of 4,400 gallons of hydrogen peroxide was delivered to the ABL's chemical mixing facility.

Colonel Pawlikowksi said the batch was a mixture of hydrogen peroxide and potassium hydroxide, a salt that enhances and sustains the chemical reaction inside the megawatt-class COIL, ABL's killer laser.

There are four lasers on the heavily modified 747-400 Freighter but only the COIL operates with liquid and gaseous chemicals. The others are lower-powered lasers used to identify, define, and track boosting missiles.

ABL is a boost-phase segment of the Missile Defense Agency's (MDA) layered system of missile defense. Other elements include a mid-course defense and a terminal-phase defense.

ABL's exclusive job is to station itself near a zone from which missiles are likely to be fired, then find, track, and destroy the weapons soon after they leave their launchers.

ABL uses infrared sensors and two of its four lasers to identify a newly launched missile and determine its suitability as a target. A third laser measures and compensates for the atmospheric disturbance between the aircraft and the target. The fourth and final laser to fire – the COIL — causes the missile to kill itself when the powerful beam heats up the metal skin over the missile's fuel tank, causing it to rupture.

YAL-1A, currently in a hangar at Edwards Air Force Base, while preparations are being made to install the COIL and the complicated optical system that guides the laser beams to the target.

The COIL beam-generating process begins when chlorine gas is injected into a spray of hydrogen peroxide and chemical salts, producing excited oxygen. Iodine gas is then mixed with the excited oxygen to produce excited iodine. When the iodine returns to it normal or ground state it emits flashes of light called photons, which are collected and amplified to create a beam capable of zeroing in on a target several hundred miles away.

Although one laser module has been successfully built and tested, manufacturing 118 percent of anticipated power, no one has ever successfully fired a unit comprised of the six modules to be used on YAL-1A, each the size of an SUV turned on end and weighing 4,500 pounds. @

IF/SN software introduces real-time targeting capabilities

by Francis L. Crumb, Information Directorate

ROME, N.Y. — Real-time targeting information available to the combat controller can now be immediately sent to Close Air Support (CAS) pilots as authorized targets over existing communication networks. This communications technology was developed by the Air Force Research Laboratory's Information and Sensors Directorates.

"This 'machine-to-machine' targeting software was introduced and tested at the 720th Special Tactics Group CAS Conference and Training Exercise Dec. 11-17 near Las Vegas," said Dr. David Hench, of the Center for Integrated Transmission and Exploitation (CITE), project engineer for the Information Directorate. "Four missions were run as part of the training exercise."

"The advanced software was used by terminal air controllers on laptop computers at the Nellis Air Force Base Test Range to produce targeting solutions and communicate to the Combined Air Operation Center (CAOC) at Nellis using satellite radios. The software was also installed in the CAOC to receive the targeting solution, and the solution was transmitted over communication links to both F-15 and F-16 CAS aircraft that were supporting the mission.

"This testing confirmed the full functionality of the software to significantly reduce the targeting-kill chain process time," Dr. Hench said. "Exercise participants were exceptionally pleased with the effectiveness and responsiveness of this new targeting technology development." @

Skeleton sled champion prepares for Olympic trials

by Pete Meltzer Jr., Materials and Manufacturing Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — For Major Brady Canfield, an Air Force scientist, many of life's toughest questions and answers reside not in a laboratory, but in the wrenching twists and turns of a mile long downhill track made of glare ice that slips one along at 80 mph, or if the conditions are just right, even faster.

So goes it for recently crowned men's national skeleton sled racing champion and World Championships bronze medallist , Major Canfield, as he gears up for the Olympic trials and counts down the days to the 2006 Winter Games in Torino, Italy.

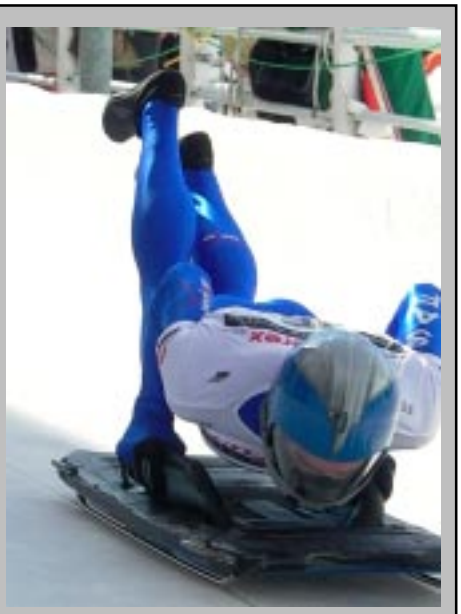
"The best overall position is difficult to hold," Major Canfield said. "My neck needs to be lower on the sled and my chin rotated one-half inch higher. To accomplish that, I'm enrolling in yoga to develop the specific flexibility I'll need, as well as sleeping on my stomach in the 'race' position for the next 892 days."

Major Canfield is steely-eyed at age 40, four years younger than his dad when *he* was a rodeo champion. One wonders if the junior Canfield's best days are still on the horizon. Today, in perhaps the best shape of his life, he is a super-motivated, intensely self-disciplined rising star striving for what many athletes consider the ultimate—an opportunity to represent the United States in Olympic competition.

Major Canfield's rise to national champion has been unwavering, persistent and dedicated—an adventure that has taken him around the world—including to St. Moritz, Switzerland, where skeleton racing originated more than 100 years ago. Skeleton, in fact, has spawned two Winter Olympic sports –bobsled and luge, and is now a regular event itself.

The typical skeleton sled is comprised of a steel chassis and steel runners and weighs about 95 pounds. The athlete lies face down on top of the sled in a headfirst position. The bottom of the sled or "pod" is comprised of a steel (sometimes fiberglass) sheet attached to the underside of the chassis to provide aerodynamic benefits, much like the underside of a high performance race car. The sled has no mechanical steering, braking or propulsion capability. It moves solely by the pushing force provided by the athlete at the beginning of the race and under the force of gravity as it winds through the course like a bullet, sometimes exposing a skeleton athlete to up to five Gs – forces of gravity.

Like all champions, Major Canfield has learned how to translate disappointment into motivation. At the U.S. national trials for the 2002 Winter Olympics in Salt Lake City, the rookie placed fourth, just one position shy of earning a spot on the men's three-man squad. That loss was disheartening, but the experience of coming so close to winning and then not winning only spurred him on.



Maj. Canfield gets off to a flying start on his skeleton sled at the top of the racing track. (Air Force photo)

"Skeleton racing is 15 percent equipment and 85 percent you," Major Canfield said. However, even from the beginning, he has sought to optimize his odds with the best equipment. Soon after entering the sport, he succeeded in gaining the support of the Air Force Research Laboratory's Advanced Composites Office at Hill Air Force Base, Utah. Engineers there proved instrumental in redesigning the aerodynamic component of the sled, called the "pod," that helped him reach the 2002 Olympic trials.

Soon, Major Canfield will begin rocketing through downhill courses in renewed hopes of earning a spot on the men's Olympic skeleton racing team. Until, then the quest for excellence continues, not only on the track but throughout the entire Materials and Manufacturing Directorate in the search for better materials and production technologies required to keep the world's best fighting force number one. @

EDITOR'S NOTE - *Major Canfield will try to defend his title as National Champion, when he competes in the 2004 U.S. Men's National Skeleton Championships, Lake Placid, N.Y., Feb 29 - March 8.*

Net Index

Due to the number of submissions we receive, some sections of *news@afrl* are available exclusively on-line. The on-line version of the newsletter allows users to view the AFRL corporate calendar, news releases generated by AFRL headquarters, operating instructions, L@b L@urels and Roundups sections.

The L@b L@urels section of the electronic newsletter is dedicated to members of Air Force Research Laboratory who receive awards and honors. The Roundups section of the electronic newsletter keeps Air Force Research Laboratory employees informed about contracts AFRL has awarded. Below is an index of articles one can find in each of these on-line sections.

Nation's largest rocket test stand ready for blast off

by Ranney Adams, Propulsion Directorate

EDWARDS AIR FORCE BASE, Calif. — The only Defense Department stand capable of performing full-scale rocket chamber development testing in the 750,000-pound thrust class was recently modernized and is ready for action.

Test Stand 2-A, one of the nation's largest rocket test stands, is primarily used for development testing advanced rocket engine turbomachinery and combustion components, but it can be used for numerous high-pressure and flow-rate propulsion systems again. It was used more than 30 years ago for Apollo Moon-mission F-1 rocket engine production testing.

Located at the Air Force Research Laboratory's Edwards Research Site, Test Stand 2-A is part of nearly $3 billion worth of facilities that have provided the nation with rocket propulsion research, development and test capabilities for more than 50 years.

Aerospace leaders from Boeing-Rocketdyne, Pratt and Whitney and Aerojet and numerous other industry and government officials attended the test stand's ribbon-cutting ceremony and made comments during the event.

Col. Mike Heil, AFRL's propulsion directorate director said, "Today is a watershed day in aerospace, a day when our national space policy is being laid out for the world."

Maj. Gen. Paul Nielsen, AFRL commander, participated in the ribbon-cutting ceremony with other Air Force officials.

"The lab's vision statement," he said, "states that 'We defend America by unleashing the power of innovative science and technology.' We believe this vision is shared by our colleagues in industry and academia who help us advance science and technology for our country. There is probably no technology we work on that exhibits that power as much as rocket propulsion power, space launch power and these facilities are in the heart of that envelope.

"I attended a ceremony here in November 2000," the general continued, "a dedication of the rocket site as a historic site by the American Institute of Aeronautics and Astronautics. It commemorated the strong foundation created here over the years by the hard work and innovation of the men and women of this facility. I love to respect the past, but even more, I like to create the future. This facility is where we create the future, where we build for the 21st century."

General Nielsen also discussed the teamwork involved with the test stand.

"Nothing like this gets done without a lot of people working together," he said. "People have commented about how well our government and industry team has worked to bring this to pass, how strongly the executive department and legislative department of the federal government have worked to bring this to pass, how united federal, state and local officials have been.

"This really can serve as an example for all people across the United States on how to bring people together to do something extremely important for the future of our country, the future of our children and the future of our grandchildren."

The first 40 years of launch vehicle and spacecraft development has been described as the first space age.

"We have done the initial exploration," said General Nielsen. "Now as we go into the 21st century, we are getting involved in the second space age, where our use of space will grow so much. I'd like to think of this facility, this great investment that people have made, as a facility that is really crucial and key to the United States development of the second space age."

General Nielsen directs the Air Force's $1.7 billion science and technology budget in addition to $1.3 billion from laboratory customers. That investment in technology research and development is conducted by the lab's 8,700 military and civilian experts at research sites across the nation.

According to Robert Drake, AFRL propulsion directorate's chief operations planner, one of the functions of DoD laboratories is to provide special-purpose facilities that are not practical for the private sector to own or operate.

"AFRL has traditionally supported the development and installation of a full-scale liquid rocket component development test capability needed for development of new rocket engine technologies," he said.

Originally designed and built in the early 1960s for Apollo's F-1 rocket engine component development and testing, the test stand has been modernized to current day standards with an $18.5 million, 18-month refurbishment effort. Officials said these modernization costs are small compared to the five-year lead time and estimated $500 million in construction costs for a brand new test stand.

Testing next-generation rocket engine components on Test Stand 2-A is intended to provide more reliable, lower-cost and higher performance rocket engines for tomorrow and adds to AFRL's assets of unique facilities that provide the nation with the most modern and complete research, development and test capabilities for rocket propulsion technology progress, officials said.

Nearly every American rocket propelled satellite, missile or launch vehicle has been touched by the technology research, development or testing conducted at the Edwards Research Site. @